UNIVERSITI PUTRA MALAYSIA

SEASONAL OCCURRENCE OF THE DURIAN FRUIT BORER, MUDARIA MAGNIPLAGA WALKER (LEPIDOPTERA: NOCTUIDAE)

LEE BOON KOK

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SEASONAL OCCURRENCE OF THE DURIAN FRUIT BORER, *MUDARIA MAGNIPLAGA* WALKER (LEPIDOPTERA: NOCTUIDAE)

BY

LEE BOON KOK

Thesis Submitted in Fulfilment of the Requirements for the Degree of Master of Agricultural Science in the Faculty of Agriculture, Universiti Pertanian Malaysia.

September 1996

DEDICATIONS

To my beloved father and mother,

LEE CHEN KOON
TEO KHENG HWEI

To my brother, brothers in law, sisters, and sisters in law,

LEE SIEW KIAT AND DANIEL SIM WEI
LEE SIEW CHENG AND KEK BOON HIN
LEE SIEW HWA
LEE SIEW YAN AND YONG KEE CHAI
LEE SIEW CHU
LEE BOON KAH

To my beloved girl friend,

LOH PIT MUI

WITHOUT WHOSE LOVE AND CONTINUED SUPPORT THIS THESIS WOULD NOT HAVE BEEN POSSIBLE.

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SEASONAL OCCURRENCE OF THE DURIAN FRUIT BORER, *MUDARIA MAGNIPLAGA* WALKER (LEPIDOPTERA: NOCTUIDAE).

By

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September, 1996

Chairman : Associate Professor Dr. Khoo Khay Chong
Faculty : Agriculture

The durian fruit borer, *Mudaria magniplaga* Walker, is the most important insect pest of durian (*Durio zibethinus* Murray) in Malaysia. Since the larva of *M. magniplaga* is known to feed only on durian fruit which are in season once or twice a year, it is necessary to understand how the phenology of the pest is related to that of the host's. Studies were carried out to: (1) determine the species of *Mudaria* infesting durian, (2) examine the phenological relationship between *M. magniplaga* and durian, (3) investigate diapause in *M. magniplaga*.

For the taxonomic study, moths were obtained from light traps and by rearing from infested durian fruit and flower buds. Based on the forewing size and pattern, and dissection of the male genitalia two species of *Mudaria* were identified of which one was *M. magniplaga* and the other an unknown (probably

new) species of *Mudaria*. Of the specimens from the light traps, 230 were *M. magniplaga* and 5 were *Mudaria* sp.; all 823 specimens from fruit were *M. magniplaga*; and from the flower buds 5 were *M. magniplaga* and 91 were *Mudaria* sp. From the results it was concluded that: (1) besides fruit *M. magniplaga* also infests the flower bud of durian, (2) the *Mudaria* sp. found infesting flower buds does not infest durian fruit, (3) the high proportion of *Mudaria* sp. may indicate either an adaptation by this species to durian flower buds or that the phenology of *M. magniplaga* was not in synchrony with that of the buds during the study period.

The phenological relationship between *M. magniplaga* and durian was studied over a two year period in the university orchard by monitoring the activity of the moth using light traps and by recording the period of the various reproductive processes of the host. Moths were caught when the flowers were anthesising; numbers peaked when fruit were in abundance and declined towards the end of the fruiting season. Very few moths were caught between the end of the fruiting season and flower anthesis in the next season. At least for this locality and period of study, the phenology of *M. magniplaga* seemed to be in synchrony with that of its host.

For the diapause study, infested fruit in various stages of development were collected from three localities: Universiti Pertanian Malaysia, Federal

Experimental Station and Jementah. The period of the pupae reared from these fruit was recorded. When frequency of pupae was plotted against the pupal period it was observed that there was a similar pattern for the three localities. The range in the pupal period was spread between 17 to 230 days with the larger proportion of adults having emerged by the 110th day. Two main peaks were discernible before the 110th day, and the lowest point between these peaks fell around the 45th day which was arbitrarily taken as the point beyond which pupae were considered to be in diapause. When percentage pupae in diapause was related to stage of fruit development (as indicated by fruit length) it was found that 2.2% of pupae entered diapause when the larvae were reared from stage 1 (<5 cm) fruit, 9.6% from stage 2 (5-10 cm) fruit, 36.2% from stage 3 (10-15 cm) fruit, and 53.0% from stage 4 (>15 cm) fruit. It appears that diapause in *M. magniplaga* is induced some time during the larval stage and that the diapause-inducing factor is the type of food available to the larva. By increasing the proportion of pupae entering diapause as the fruit develops the species seems to be well adapted for the lengthy period when food for the larvae is unavailable.

A study was carried out in an attempt to elucidate the diapause terminating factor. It was hypothesised that the odour of the anthesising durian flower is such a factor. Pupae were exposed to fresh anthesising flower in the laboratory. The results showed no significant difference between treatment and

control in the pupal period. Thus the odour of the durian blossom may not be responsible for terminating diapause in *M. magniplaga*.

Overall, this study has shown that *M. magniplaga* seems to have adapted to durian through its ability to synchronise its phenology with that of its host.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia bagi memenuhi keperluan Ijazah Master Sains Pertanian.

MUSIM KEWUJUDAN PENGOREK BUAH DURIAN, *MUDARIA MAGNIPLAGA* WALKER (LEPIDOPTERA: NOCTUIDAE)

Oleh

LEE BOON KOK

September, 1996

Pengerusi : Profesor Madya Dr. Khoo Khay Chong
Fakulti : Pertanian

Pengorek buah durian, *Mudaria magniplaga* Walker merupakan serangga perosak yang paling utama bagi durian (*Durio zibethinus* Murray) di Malaysia. Oleh sebab larva *M. magniplaga* diketahui hanya makan buah durian, buah ini bermusim satu atau dua kali setahun, maka perlulah difahami bagaimana fenologi serangga ini berhubungkait dengan perumahnya. Kajian telah dijalankan untuk (1) menentukan spesies *Mudaria* yang menyerang durian, (2) mengkaji hubungan fenologi antara *M. magniplaga* dan durian, (3) mengkaji diapaus pada *M. magniplaga*.

Bagi kajian taksonomi, serangga diperolehi daripada perangkap cahaya serta melalui pemeliharan daripada buah dan kudup bunga durian yang diserang. Berdasarkan saiz dan corak kepak hadapan serta melalui pembedahan genitalia

jantan, dua spesies *Mudaria* telah dikenal pasti yang mana salah satunya ialah *M. magniplaga* dan yang satu lagi merupakan *Mudaria* yang tidak dapat dipastikan spesiesnya (kemungkin spesies baru). Antara spesimen yang didapati daripada perangkap cahaya, 230 merupakan *M. magniplaga* dan 5 adalah *Mudaria* sp.; kesemua 823 spesimen yang diperolehi daripada buah durian merupakan *M. magniplaga*; dan daripada kudup bunga, 5 merupakan *M. magniplaga* dan 91 adalah *Mudaria* sp. Daripada keputusan, dapatlah disimpulkan: (1) selain daripada buah *M. magniplaga* juga menyerang kudup durian, (2) *Mudaria* sp. yang didapati menyerang kudup bunga tidak menyerang buah durian, (3) perkadaran yang besar bagi *Mudaria* sp. mungkin menunjukkan sama ada penyesuaian spesies ini terhadap kudup bunga durian atau pun fenologi *M. magniplaga* tidak bersinkroni dengan kudup bunga durian dalam jangka masa kajian.

Hubungan fenologi di antara *M. magniplaga* dan durian telah dikaji dalam jangka masa dua tahun di ladang universiti secara mangawasi aktiviti serangga dengan penggunaan perangkap cahaya dan pengambilan data untuk jangka masa berbagai proses perkembangan perumah. Rama-rama ditangkap sewaktu antesis bunga; bilangan serangga memuncak semasa kelimpahan buah dan mulai berkurangan sehingga ke penghujung musim buah. Bilangan rama-rama yang ditangkap di antara penghujung musim buah dan antesis bunga berikutnya adalah

sedikit. Sekurang-kurangnya pada lokasi dan jangka masa pengajian ini, fenologi *M. magniplaga* diperhatikan bersinkroni dengan perkembangan perumahnya.

Untuk kajian diapaus, buah durian yang diserang pada berbagai peringkat perkembangan telah diperolehi daripada tiga lokasi, iaitu Universiti Pertanian Malaysia, Federal Experimental Station, dan Jementah. Tempoh pemeliharaan kepompong daripada buah tersebut telah dicatatkan. Apabila keluk bilangan kepompong diplotkan terhadap tempoh kepompong, corak yang sama didapati pada ketiga-tiga lokasi ini. Taburan tempoh kepompong adalah dari 17 ke-230 hari dengan perkadaran yang tinggi bagi serangga dewasa muncul dalam 110 hari. Dua puncak utama yang jelas didapati sebelum hari yang ke-110, dan titik yang paling rendah di antara kedua-dua puncak ini adalah pada hari ke-45 di mana titik ini diambil secara arbitrari sebagaimana tempoh kepompong yang lebih panjang daripada ini dipertimbangkan berada dalam keadaan diapaus. Apabila peratus kepompong yang berada pada keadaan diapaus dihubungkaitkan dengan peringkat perkembangan buah (diwakili oleh panjang buah), didapati 2.2% kepompong berada dalam keadaan diapaus apabila larva dipelihara daripada buah peringkat 1 (<5 cm), 9.6% daripada buah peringkat 2 (5-10 cm), 36.2% daripada buah peringkat 3 (10-15 cm), dan 53.0% daripada buah peringkat 4 (>15 cm). Ini menunjukkan bahawa diapaus pada *M. magniplaga* telah diaruh sewaktu berada pada peringkat larva. Dengan ini, faktor aruhan diapaus merupakan jenis makanan yang boleh didapati oleh larva. Dengan meningkatkan perkadaran

kepompong yang diapaus apabila buah berkembang, spesies ini dapat menyesuaikan diri dengan baik dalam jangka masa yang panjang sewaktu ketiadaan makanan untuk larva.

Satu kajian untuk mejelaskan faktor penamatan diapaus telah dijalankan. Hipotesis telah andaikan bahawa haruman bunga durian merupakan salah satu faktor penamatan diapaus. Kepompong telah didedahkan kepada bunga sedang antesis yang segar di dalam makmal. Keputusan menunjukkan tiada perbezaan yang ketara di antara rawatan dan kawalan bagi tempoh kepompong. Oleh yang demikian, haruman bunga durian yang berkembang mungkin bukan faktor yang mempengaruhi penamatan diapause pada *M. magniplaga*.

Secara keseluruhan, kajian ini menunjukkan bahawa *M. magniplaga* telah menyesuaikan diri terhadap durian melalui keupayaan fenologinya bersinkroni dengan perumah.

CHAPTER I

INTRODUCTION

Durian, *Durio zibethinus* Murray, commonly known as the king of tropical fruits, is one of the most fascinating fruits in Southeast Asia. To the locals, no other fruits surpasses the durian in terms of its peculiar smell and exquisite taste. Nutritionally, the aril of durian is rich in protein (Zanariah and Noor Rehan, 1987) and vitamin C (Faridah and Ragab, 1969).

Durian is widely cultivated in Malaysia and Thailand and is one of the more economically important fruit crops in the tropics. With the potentially high returns that can be derived from a durian orchard, many farmers are venturing into planting of this fruit. In Peninsular Malaysia, the area planted with durian has increased from 48,000 hectare in 1988 to 83,000 hectare in 1993 (Malaysia, Ministry Agric., 1989; 1994) and is expected to continue to increase. However, there are a number of problems which adversely affect the productivity and quality of the durian fruits, and make planting of durian a risky business.

In the central region of Peninsular Malaysia, flowering and fruiting is seasonal: anthesis normally occurs between February-March and September-October (Malaysia, Koperasi Kakitangan Kementerian Pertanian Berhad, 1989). In the northern and southern regions, fruiting occurs only once, between February-March. Secondary flowering may also occur between the main fruiting seasons. Flower development takes between five to seven weeks and trees are in blossom for about three weeks (Soepadmo and Eow, 1977). During this period, the flowers emit a musky odour (Meense, 1961). Mature fruits drop three to four months after anthesis.

There are a number of insect pests in durian. Among these are the durian psyllid, *Allocarsidara malayensis* Crawford (Homoptera: Carsidaridae) (Saet, 1986), the yellow peach moth, *Conogethes punctiferalis* Guenee (Lepidoptera: Pyralidae) (Khoo et al., 1991), and the durian fruit borer, *Mudaria magniplaga* Walker (Yunus and Balasubramaniam, 1981). However, there are few published reports on these problems. Also, there are few reports on the management of durian pests.

M. magniplaga is one of three *Mudaria* species recorded as borers of durian fruits. The other two are *Mudaria luteileprosa* Holloway (Tan and Tan, 1991) and *Mudaria leprosticta* Hampson (Kalshoven, 1981). The former species was recently reported in Malaysia and the latter in Indonesia. However, *M. magniplaga* is the most common and important borer of durian fruits in Malaysia

and the present study has focused on this species. The larvae attack the fruit at all stages of development (Lee, 1993) causing the fruit to be unmarketable.

Despite its importance as a pest, very little is known about *M. magniplaga*. Control largely involves the use of insecticides and light traps but there is no scientific basis for these measures. The pests could be managed more effectively and efficiently if more basic information is made available.

Since the durian tree fruits only once or twice a year, species of *Mudaria* that feed on the fruit have to survive long periods without its usual source of food. It has been reported that the pupal period of *M. magniplaga* can be as long as 10 months (Yunus and Balasubramaniam, 1981). However, a study by Lee (1993) revealed that the mean pupal duration was 19 days. It is then reasonable to suspect that as a species, *M. magniplaga*, survives periods of adversity by undergoing diapause. Therefore, this study investigates occurrence of diapause in *M. magniplaga*.

In summary, this study had the following objectives:

1. To identify the species of *Mudaria* infesting durian
2. To understand the temporal relationship between *M. magniplaga* and its host
3. To determine if diapause occurs in *M. magniplaga*
4. To examine the effect of fruit size on diapause induction
5. To study the effect of durian flower odour on diapause termination

CHAPTER II

LITERATURE REVIEW

Mudaria spp.

The genus *Mudaria* was first described in 1893 and the type species *Mudaria cornifrons* Moore was recorded as a borer of silk-cotton pods, *Bombax* sp. in India (Moore, 1893). Later, this genus was reviewed and found to be similar to the genus *Plagideicta* in its pale forewing ground colour, forewing pattern elements, and genitalic features (Holloway, 1989). Therefore, together with the species *rudolfi* Kobes **comb. n.** and *nubes* Kobes **comb. n.** all taxa of the genus of *Plagideicta* were changed to *Mudaria.*

So far, larvae of *Mudaria* have only been recorded as borers of pods or fruits in the family Bombacaceae. The centre of diversity of *Mudaria* is believed to be the Sunda Islands and this is reflected in the diversity of its host family (Holloway, 1989). Today, 18 species of *Mudaria* have been recorded (Table 1) but only three were reported as borers of durian fruit, these being

Table 1

Species of *Mudaria*

No	Species	Synonym	Year first recorded	Host plant	Geographical range	Reference
1	*M. albonotata* Hampson	*Plagideicta albonotata* Hampson	-	-	Sri Lanka	Holloway, 1982
2	*M. cornifrons* Moore	(Type species)	1893	Silk-cotton	India	Moore, 1893
3	*M. gigas* Holloway	*Plagideicta gigas* Holloway	1982	-	Malaysia	Holloway, 1982
4	*M. leprosa* Hampson	*Plagideicta leprosa* Hampson	-	-	Himalaya	Holloway, 1982
5	*M. leprosticta* Hampson	*Hypoperigea leprosticta* Hampson	-	Durian	Indonesia, Sri Lanka	Kalshoven, 1981;
		Plagideicta leprosticta Hampson (Type species)	1914			Holloway, 1982
6	*M. luteileprosa* Holloway		1989	Durian	Brunei, Malaysia	Tan and Tan, 1991
7	*M. magniplaga* Walker	*Thyatira magniplaga* Walker	1858	Durian	Brunei, Malaysia	Holloway, 1989;
		Plagideicta magniplaga Holloway	1982			Tan and Tan, 1991
8	*M. major* Warren	*Plagideicta leprosticta major* Warren	1914	-	Himalaya, Indonesia,	Holloway, 1989
		Plagideicta batesoni Holloway	1976		Malaysia	
		Plagideicta major Warren	1982			
9	*M. minor* Holloway	*Plagideicta minor* Holloway	1982	-	Indonesia, Malaysia	Holloway, 1982
10	*M. minoroides* Holloway		1989	-	Brunei, Malaysia	Holloway, 1989
11	*M. nubes* Kobes		-	-	Indonesia	Holloway, 1989
12	*M. rudolfi* Kobes		-	-	Indonesia, Malaysia	Holloway, 1989
13	*M. solidata* Warren	*Plagideicta solidata* Warren	1982	-	Indonesia	Holloway, 1982
		Hypoperigea leprosticta ab. confluens Strand	1921			
14	*M. tayi* Holloway	*Plagideicta tayi* Holloway	1976	-	Indonesia, Malaysia	Holloway, 1989
15	*M. turbata* Walker	*Eurois turbata* Walker	1858	-	Borneo, Himalaya,	Holloway, 1989
		Plagideicta turbata Walker	1914		India, Myanmar	
16	*M. variabilis* Roepke		1916	Kapok	Indonesia	Holloway, 1989
17	*M. wallacea* Holloway	*Plagideicta wallacea* Holloway	1982	-	Philippines	Holloway, 1982
18	*Mudaria* sp.		1989	-	Borneo	Holloway, 1989